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Massachusetts Institute of Technology
Kavli Institute for Astrophysics and Space Research (MKI)

Packaging, Packing, Handling, Storage and Transportation (ACIS)

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Table of Contents

Preface

1.0 Scope

This procedure covers the packaging, packing, handling, storage, and transportation requirements for AXAF CCD Imaging Spectrometer (ACIS) fight Science Instrument. It is mounted on the LMA SIM-Sim, and excludes the PSMC and external calibration source. The ACIS will be used on the Advanced X-ray Astrophysics Facility (AXAF).

1.1 Objective

The objective of this procedure is the prevention of damage due to contamination, electrostatic discharge (ESD) and physical stress to flight hardware.

2.0 Reference Documents

The latest revision of the following drawings, procedures, and documents are applicable, to the extent specified herein.

MIT	
36-02023	Procedure for Installing Optical Witness Samples (OWS)
36-02027	Cleaning/Cleanliness Control for Electronic Assemblies
36-01316	Cleanroom Dressing, Behavior, Material Handling, Work Area Preparation, and Bagging Procedure
36-30000	Flight Support Assembly
36-60221	SIM-Sim Lifting Fixture Assembly
99-01003	Handling for Static Sensitive Electronics
99-03002	Connector Mating and Demating Procedures
FSH 20 mod.	Portable Hoist
LMA	
IE 4210	ACIS Shipping Container
849AC711100-009	Vacuum Control Unit
Government	
FED-STD-209	Airborne Particulate Cleanliness Classes in Cleanrooms and Clean Zones
MIL-STD 1246	Product Cleanliness Levels and Contamination Control Program
MSFC-STD 126	Inspection, Maintenance, Proof testing and Certification of Handling Equipment
MSFC-STD-1238	Thermal Vacuum Bakeout Specificati0n for Contamination Sensitive hardware

3.0 Procedure

3.1 ESD Controls

The ACIS Instrument is fabricated, for the most part, with CMOS parts. As such, the electronics are highly susceptible to Electrostatic Damage (ESD). In addition the detectors are Charge Coupled Devices (CCDs) which are susceptible to ESD in the range of tens of volts. Therefore, proper grounding and ESD protection is required at all times. The procedures of 99-0100 or equivalent are mandatory.

3.2 Contamination Control

The Detector Assembly is used to detect low energy X-Rays down to 0.2 keV. Contamination in the range of angstroms (Å) will greatly reduce or even block the very X-ray that ACIS is designed to detect. The ACIS Instrument and the associated electronics are built in a clean room environment. The hardware is certified to MSFC-SPEC-1238 and should be considered contamination critical. Warning labels should be on the outside of the containers and bags, identifying the type of clean room required, prior to opening. In addition, warning labels should identify the material as "MSFC-SPEC-1238 Certified". Prior to packaging, the MIT Contamination Control Engineer will inspect the instrument, and clean if necessary, using an ESD safe vacuum cleaner. Non painted surfaces may be cleaned using 200 proof ethanol. Painted surfaces shall be cleaned with a clean room cloth, lightly dampened with 200 proof ethanol. In addition, he is responsible for double bagging the instrument for shipment or storage per 36-01316 paragraphs 3.7, 3.8 and 3.9. An Optical Witness Sample (OWS), pre-measured by MSFC for its reflectance value, will be mounted on the SIM-sim plate and exposed just prior to package closure and sealing. A control OWS, which is sullied by MSFC along with the witness sample used above, shall accompany the instrument. These OWS's will be used to monitor contamination of the Flight Support Assembly during shipping and storage. These OWS's shall be removed and re-measured for change in reflectance, by MSFC upon removal of the inner bag. If the change in reflectance is greater than 3%, consult the MIT contamination Engineer for disposition. If this OWS is removed for measuring, a new OWS with it's control, shall be installed for future monitoring and measurements.

The inner and outer bags of the packaging will be purged with dry nitrogen with seven times (7X) the volume of each individual bag. The purge will prevent moisture condensation at low temperatures during transportation and storage.

The high and low conductance vent valves and connector shall be accessible without the need to remove the bagging material on the instrument. These locations shall be covered with clean caps and bagged. When removing these caps, ensure clean gloves are worn in order to prevent any cross contamination onto the high and low conductance vent valves and connector.

3.3 Lifting

The Support Assembly, Flight (36-3000) shall be lifted using the DEA/DPA Lifting Fixture Assembly (36-60213). The SIM-sim Support Assembly (36-60218) shall be lifted using the SIM-Sim Lifting Fixture Assembly (36-60221). At MIT, Lincoln Labs, and Lockheed Martin Astronautics (LMA), the Portable Hoist (FSH 20 mod. S/N 11332) shall be used. The Portable Hoist was proof tested on 11/26/96 at 750 pounds and the SIM-Sim lifting fixtures were proof tested on 01/27/97 at 600 pounds. All handling and lifting equipment must be certified within 48 hours prior to use on critical lift of ACIS Flight Hardware, in accordance with MSFC-STD-126. The documentation for Critical Lifting System Certification is attached as Appendix A.

3.4 Shipping Container

The ACIS Shipping Container (IE4210) is specifically designed to protect the flight instrument during transportation and storage. The Flight Instrument, as mounted on the SIM-sim shall be installed in the shipping container using the SIM-Sim Lifting Fixture Assembly (36-60221) and at MIT, Lincoln Labs, and LMA, the Portable Hoist (FSH 20 mod. S/N 11332). The SIM-Sim plate shall be attached to the vibration/shock mounts of the shipping container using a minimum of seven (7) ½-13 X 2" UNC socket head cap screws. The fasteners shall be torqued to 65 foot pounds.

A vibration/shock watch, temperature monitor, and humidity monitor shall be attached to the science instrument mounting to record environmental conditions during transportation and storage.

After the Shipping Container Cover is installed and sealed, the purge port shall be opened and the shipping container shall be purged with dry nitrogen with seven (7X) ties the volume of the bagged instrument. The purge valve is then closed, thus assuring the interior of the shipping container is in a dry nitrogen atmosphere.

3.5 Transportation

The flight instrument shall be transported by surface commercial carrier using Roberts White Glove Service or equivalent. The truck shall be equipped with pneumatic suspension and the cargo area shall be equipped with automatic temperature control. An MT employee must escort the Flight Instrument during transportation. The route and schedule will be approved by the MIT escort.

3.6 Storage

The Flight Instrument must be prepared, packaged, packed, and sealed in the shipping container (paragraphs 3.1 through 3.4 above) for storage, not to exceed fourteen (14) days. Storage may continue indefinitely in the shipping container providing the low pressure in the detector assembly is renewed every fourteen (14) days. The Vacuum Control Unit (849AC711100-009) and supporting hardware is the Vacuum Ground Support Equipment (VGSE) supplied for this purpose.

4.0 Controlled Area

The shipping container must be in a controlled area with a Class 100K (or better) environment per FED-STD-209, when the shipping container cover is removed.

Similarly, the ACIS flight instrument must be in a controlled area when the inner bag is removed. However, the controlled area must have a Class 2000 (or better) environment per FED-STD-209. The controlled area is an area which has limited access, a controlled environment, per FED-STD-209, and has a static free work area per paragraph 4.0 of 99-01003, or equivalent. A ground strap must be connected to the SIM-Sim when the flight unit is removed from the inner bag.

The ACIS is required to be maintained clean per MSFC-SPEC-1238. Any bagging material shall meet the requirements of MSFC-SPEC-1238. When the instrument is exposed to atmospheric conditions, silicon witness samples must be used to monitor contamination. Also, exposed silicon witness samples must be exposed within the inner bag. The total accumulation of contamination is not to exceed level 350A of MIL-STD-1246, from the time the ACIS was removed from the vacuum chamber. A running tally is to be maintained by the MIT Contamination Engineer.

Appendix A

Massachusetts Institute of Technology
Kavli Institute for Astrophysics and Space Research
CAMBRIDGE, MASSACHUSETTS 02139

CRITICAL LIFTING SYSTEM CERTIFICATION

(MSFC-STD-126E)

ACIS Program Critical Hardware

Location of Lift (Facility/Building)

_____

Weight to be lifted (pounds)

(a) Item _____

(b) Special lifting equipment _____

Date of Lift

(c) Total _____

_____ Hoist Identification _____

_____

(a) Pre critical Lift Assessment

(1) Equipment labeled with appropriate maximum working load _____

(2) Load to be lifted does not exceed maximum working load _____

(b) Visual inspection of hoist and special lifting equipment shows no evidence of damage, excessive wear, or abuse _____

(c) Dummy load lift must be 110% (minimum) of the critical load plus the special handling and lifting equipment. Test requires three (3) lifts. If program critical hardware will be held at a specific height by the lifting equipment, the third dummy load lift shall be held for five (5) minutes.

Dummy load (110% of above total) _____

Three successful lifts (ok or 3) _____

Five (5) minute hold (if required) _____

_____

I certify that the critical lifting system has been checked and found to be in compliance with critical lift requirements.

_____ _____ _____ _____

Responsible Operator Date QA Representative Date